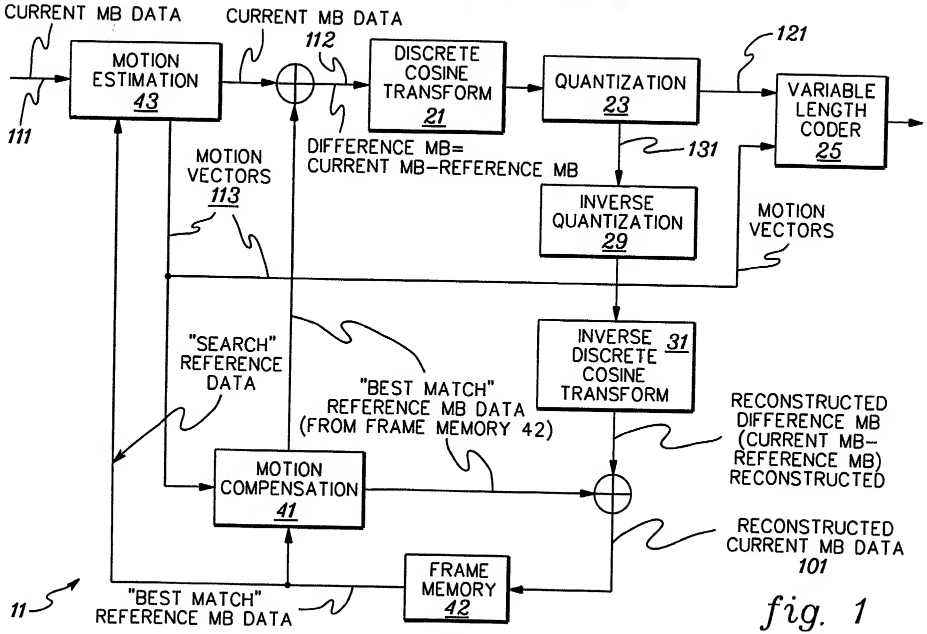

CURRENT MB DATA
111
MOTION ESTIMATION 43
CURRENT MB DATA
112
DISCRETE COSINE TRANSFORM 21
QUANTIZATION 23
121
VARIABLE LENGTH CODER 25
DIFFERENCE MB=
CURRENT MB–REFERENCE MB
131
MOTION VECTORS 113
INVERSE QUANTIZATION 29
MOTION VECTORS
"SEARCH" REFERENCE DATA
INVERSE DISCRETE COSINE TRANSFORM 31
"BEST MATCH" REFERENCE MB DATA (FROM FRAME MEMORY 42)
RECONSTRUCTED DIFFERENCE MB (CURRENT MB– REFERENCE MB) RECONSTRUCTED
MOTION COMPENSATION 41
RECONSTRUCTED CURRENT MB DATA 101
FRAME MEMORY 42
11
"BEST MATCH" REFERENCE MB DATA

fig. 1

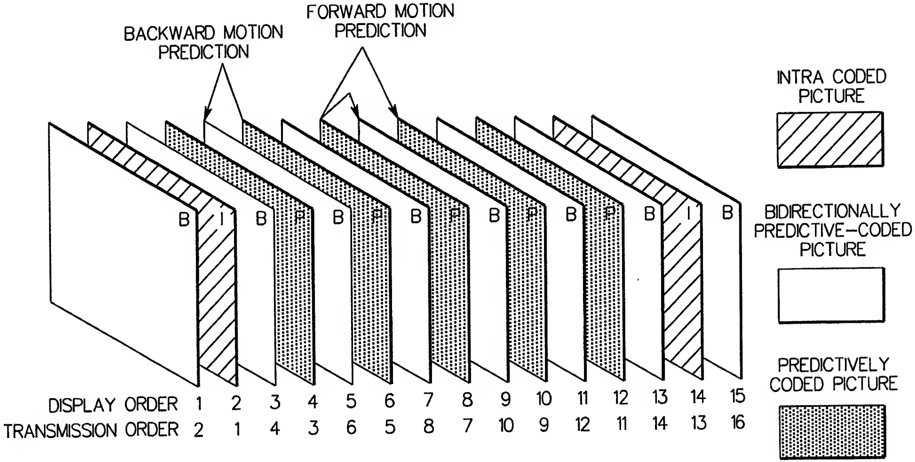

BACKWARD MOTION PREDICTION
FORWARD MOTION PREDICTION
B
I
B
P
B
P
B
P
B
P
B
P
B
I
B
DISPLAY ORDER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TRANSMISSION ORDER 2 1 4 3 6 5 8 7 10 9 12 11 14 13 16
INTRA CODED PICTURE
BIDIRECTIONALLY PREDICTIVE-CODED PICTURE
PREDICTIVELY CODED PICTURE

fig. 2

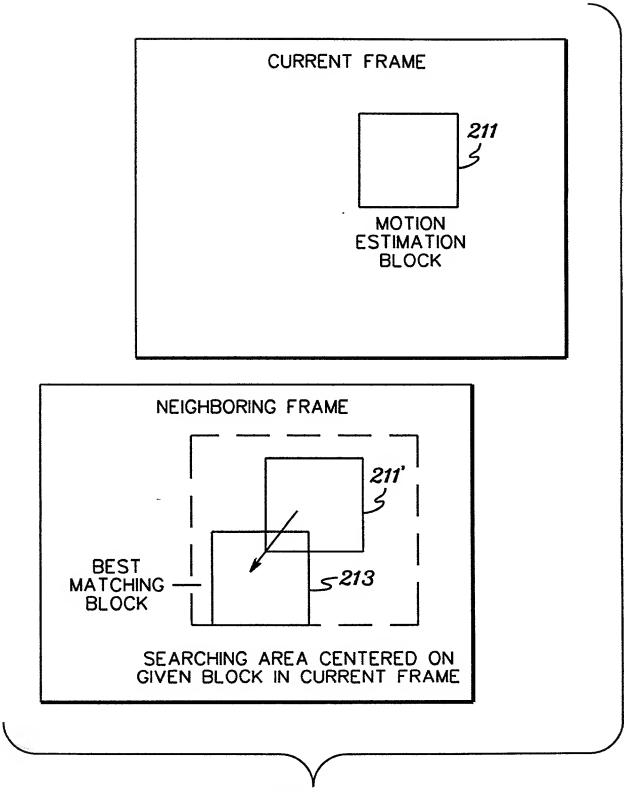
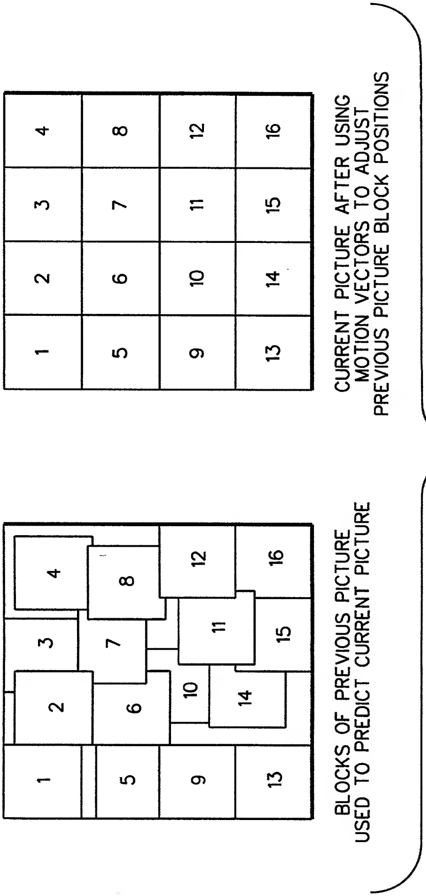

CURRENT FRAME
211
MOTION ESTIMATION BLOCK
NEIGHBORING FRAME
211'
BEST MATCHING BLOCK
213
SEARCHING AREA CENTERED ON GIVEN BLOCK IN CURRENT FRAME

fig. 3



BLOCKS OF PREVIOUS PICTURE USED TO PREDICT CURRENT PICTURE

CURRENT PICTURE AFTER USING MOTION VECTORS TO ADJUST PREVIOUS PICTURE BLOCK POSITIONS

fig. 4

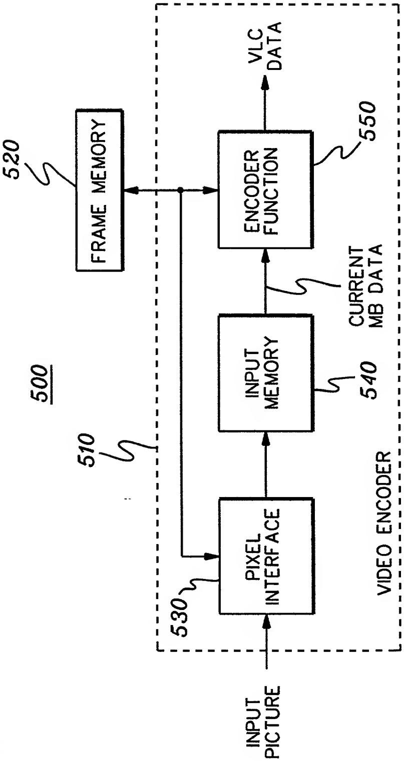

500
520
FRAME MEMORY
510
VLC DATA
550
ENCODER FUNCTION
CURRENT MB DATA
540
INPUT MEMORY
530
PIXEL INTERFACE
VIDEO ENCODER
INPUT PICTURE

fig. 5

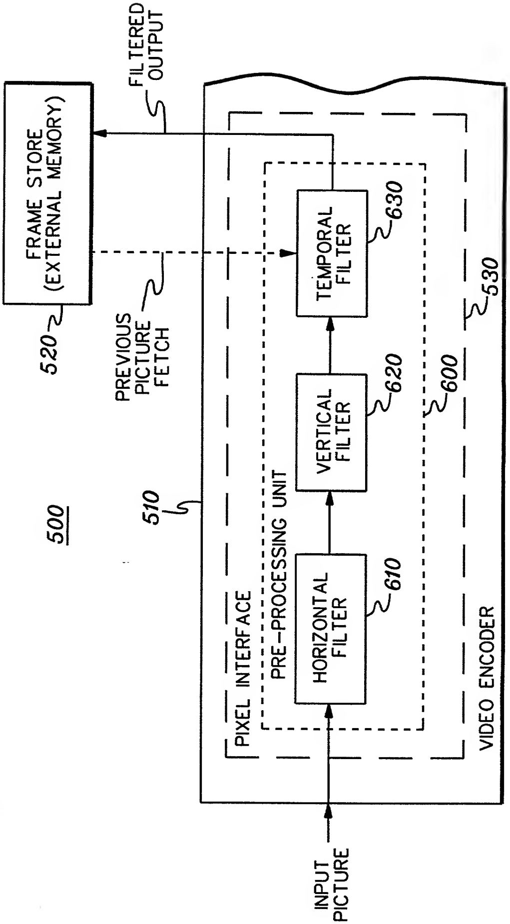

500
FRAME STORE
(EXTERNAL MEMORY)
520
FILTERED
OUTPUT
PREVIOUS
PICTURE
FETCH
510
PIXEL INTERFACE
PRE–PROCESSING UNIT
HORIZONTAL
FILTER
610
VERTICAL
FILTER
620
TEMPORAL
FILTER
630
600
530
VIDEO ENCODER
INPUT
PICTURE

fig. 6

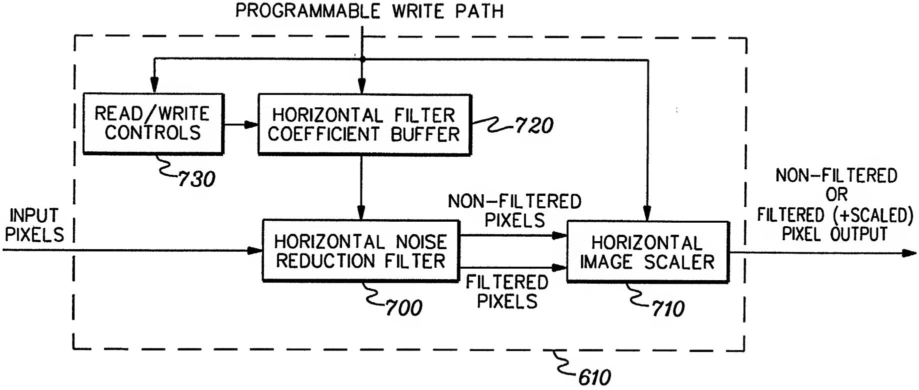

PROGRAMMABLE WRITE PATH
READ/WRITE CONTROLS
730
HORIZONTAL FILTER COEFFICIENT BUFFER
720
INPUT PIXELS
HORIZONTAL NOISE REDUCTION FILTER
700
NON-FILTERED PIXELS
FILTERED PIXELS
HORIZONTAL IMAGE SCALER
710
NON-FILTERED OR FILTERED (+SCALED) PIXEL OUTPUT
610

fig. 7

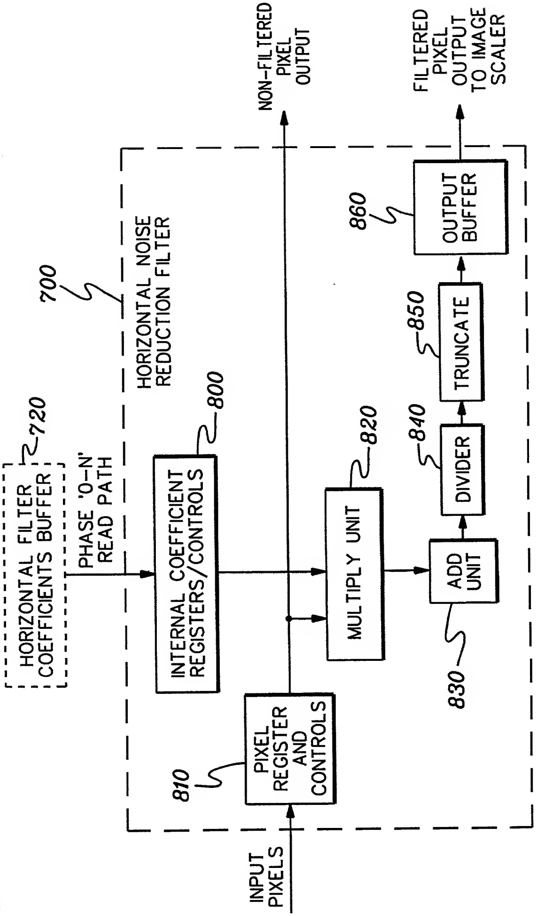

HORIZONTAL FILTER COEFFICIENTS BUFFER
720
PHASE '0-N' READ PATH
700
HORIZONTAL NOISE REDUCTION FILTER
INTERNAL COEFFICIENT REGISTERS/CONTROLS
800
PIXEL REGISTER AND CONTROLS
810
INPUT PIXELS
MULTIPLY UNIT
820
ADD UNIT
830
DIVIDER
840
TRUNCATE
850
OUTPUT BUFFER
860
NON-FILTERED PIXEL OUTPUT
FILTERED PIXEL OUTPUT TO IMAGE SCALER

fig. 8

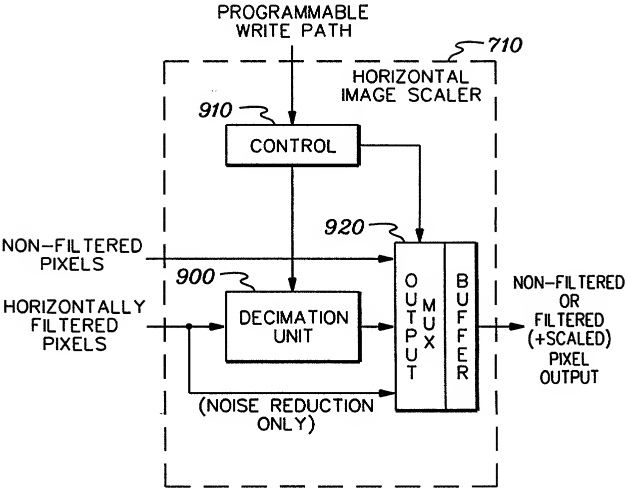

PROGRAMMABLE WRITE PATH
710
HORIZONTAL IMAGE SCALER
910
CONTROL
920
NON-FILTERED PIXELS
900
HORIZONTALLY FILTERED PIXELS
DECIMATION UNIT
OUTPUT MUX
BUFFER
NON-FILTERED OR FILTERED (+SCALED) PIXEL OUTPUT
(NOISE REDUCTION ONLY)

fig. 9

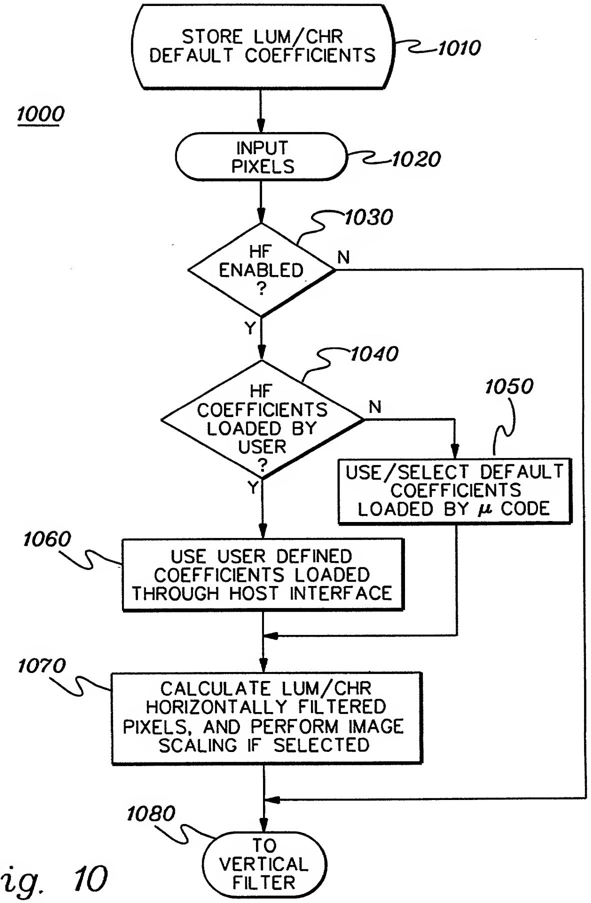

1000
STORE LUM/CHR DEFAULT COEFFICIENTS
1010
INPUT PIXELS
1020
1030
HF ENABLED ?
N
Y
1040
HF COEFFICIENTS LOADED BY USER ?
N
Y
1050
USE/SELECT DEFAULT COEFFICIENTS LOADED BY μ CODE
1060
USE USER DEFINED COEFFICIENTS LOADED THROUGH HOST INTERFACE
1070
CALCULATE LUM/CHR HORIZONTALLY FILTERED PIXELS, AND PERFORM IMAGE SCALING IF SELECTED
1080
TO VERTICAL FILTER

fig. 10

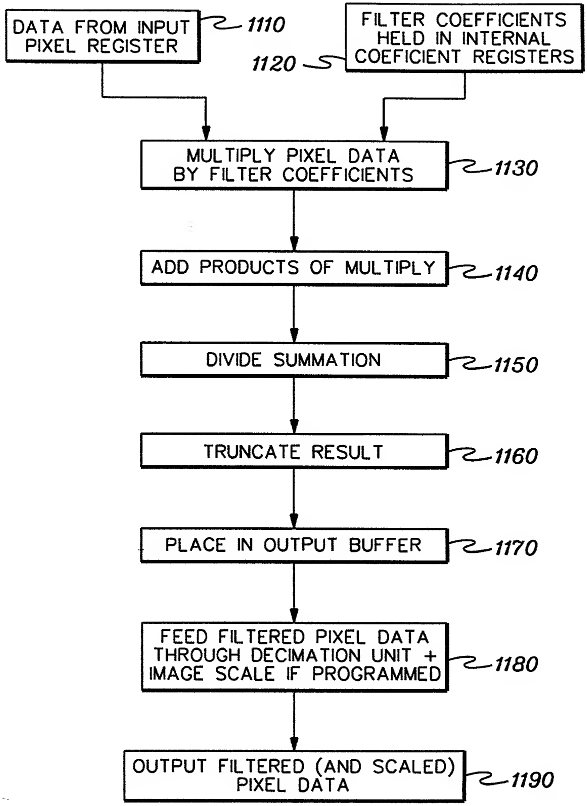

DATA FROM INPUT PIXEL REGISTER
1110
FILTER COEFFICIENTS HELD IN INTERNAL COEFICIENT REGISTERS
1120
MULTIPLY PIXEL DATA BY FILTER COEFFICIENTS
1130
ADD PRODUCTS OF MULTIPLY
1140
DIVIDE SUMMATION
1150
TRUNCATE RESULT
1160
PLACE IN OUTPUT BUFFER
1170
FEED FILTERED PIXEL DATA THROUGH DECIMATION UNIT + IMAGE SCALE IF PROGRAMMED
1180
OUTPUT FILTERED (AND SCALED) PIXEL DATA
1190

fig. 11

KEY: HORIZONTAL NOISE REDUCTION FILTER AND SCALER

(EXAMPLE: NOISE REDUCTION ONLY)
P= 'ORIGINAL' PIXELS
C= FILTER COEFFICIENTS ('PHASE 0' ONLY) C_1-C_8
F= FILTERED PIXEL OUTPUT

BEGINNING OF LINE (LUMINANCE DATA)

$$[(P_1 \bullet C_1)+(P_1 \bullet C_2)+(P_1 \bullet C_3)+(P_1 \bullet C_4)+(P_2 \bullet C_5)+(P_3 \bullet C_6)+(P_4 \bullet C_7)+(P_5 \bullet C_8)]/256 = F_1$$
$$[(P_1 \bullet C_1)+(P_1 \bullet C_2)+(P_1 \bullet C_3)+(P_2 \bullet C_4)+(P_3 \bullet C_5)+(P_4 \bullet C_6)+(P_5 \bullet C_7)+(P_6 \bullet C_8)]/256 = F_2$$
$$[(P_1 \bullet C_1)+(P_1 \bullet C_2)+(P_2 \bullet C_3)+(P_3 \bullet C_4)+(P_4 \bullet C_5)+(P_5 \bullet C_6)+(P_6 \bullet C_7)+(P_7 \bullet C_8)]/256 = F_3$$
$$[(P_1 \bullet C_1)+(P_2 \bullet C_2)+(P_3 \bullet C_3)+(P_4 \bullet C_4)+(P_5 \bullet C_5)+(P_6 \bullet C_6)+(P_7 \bullet C_7)+(P_8 \bullet C_8)]/256 = F_4$$
$$[(P_2 \bullet C_1)+(P_3 \bullet C_2)+(P_4 \bullet C_3)+(P_5 \bullet C_4)+(P_6 \bullet C_5)+(P_7 \bullet C_6)+(P_8 \bullet C_7)+(P_9 \bullet C_8)]/256 = F_5$$

$$\vdots$$

END OF LINE (HORIZ. SIZE = 720 PIXELS)

$$[(P_{713} \bullet C_1)+(P_{714} \bullet C_2)+(P_{715} \bullet C_3)+(P_{716} \bullet C_4)+(P_{717} \bullet C_5)+(P_{718} \bullet C_6)+(P_{719} \bullet C_7)+(P_{720} \bullet C_8)]/256=F_{716}$$
$$[(P_{714} \bullet C_1)+(P_{715} \bullet C_2)+(P_{716} \bullet C_3)+(P_{717} \bullet C_4)+(P_{718} \bullet C_5)+(P_{719} \bullet C_6)+(P_{720} \bullet C_7)+(P_{720} \bullet C_8)]/256=F_{717}$$
$$[(P_{715} \bullet C_1)+(P_{716} \bullet C_2)+(P_{717} \bullet C_3)+(P_{718} \bullet C_4)+(P_{719} \bullet C_5)+(P_{720} \bullet C_6)+(P_{720} \bullet C_7)+(P_{720} \bullet C_8)]/256=F_{718}$$
$$[(P_{716} \bullet C_1)+(P_{717} \bullet C_2)+(P_{718} \bullet C_3)+(P_{719} \bullet C_4)+(P_{720} \bullet C_5)+(P_{720} \bullet C_6)+(P_{720} \bullet C_7)+(P_{720} \bullet C_8)]/256=F_{719}$$
$$[(P_{717} \bullet C_1)+(P_{718} \bullet C_2)+(P_{719} \bullet C_3)+(P_{720} \bullet C_4)+(P_{720} \bullet C_5)+(P_{720} \bullet C_6)+(P_{720} \bullet C_7)+(P_{720} \bullet C_8)]/256=F_{720}$$

fig. 12

KEY: HORIZONTAL NOISE REDUCTION FILTER AND SCALER
(EXAMPLE: 2/3 HORIZONTAL IMAGE SCALING)
P= 'ORIGINAL' PIXELS
C= FILTER COEFFICIENTS – (C_1-C_8) (PHASE 0 AND PHASE 1)
F= FILTERED PIXEL OUTPUT

BEGINNING OF LINE (LUMINANCE DATA)

$$\hookrightarrow [(P_1 \bullet C_1)+(P_1 \bullet C_2)+(P_1 \bullet C_3)+(P_1 \bullet C_4)+(P_2 \bullet C_5)+(P_3 \bullet C_6)+(P_4 \bullet C_7)+(P_5 \bullet C_8)]/256$$

(C_1-C_8) PHASE 0 $= F_1$ (KEEP)

$$[(P_1 \bullet C_1)+(P_1 \bullet C_2)+(P_1 \bullet C_3)+(P_2 \bullet C_4)+(P_3 \bullet C_5)+(P_4 \bullet C_6)+(P_5 \bullet C_7)+(P_6 \bullet C_8)]/256$$

(C_1-C_8) PHASE 1 $= F_2$ (KEEP)

$$[(P_1 \bullet C_1)+(P_1 \bullet C_2)+(P_2 \bullet C_3)+(P_3 \bullet C_4)+(P_4 \bullet C_5)+(P_5 \bullet C_6)+(P_6 \bullet C_7)+(P_7 \bullet C_8)]/256$$

(C_1-C_8) PHASE 1 $= F_3$ (DROP)

$$[(P_1 \bullet C_1)+(P_2 \bullet C_2)+(P_3 \bullet C_3)+(P_4 \bullet C_4)+(P_5 \bullet C_5)+(P_6 \bullet C_6)+(P_7 \bullet C_7)+(P_8 \bullet C_8)]/256$$

(C_1-C_8) PHASE 0 $= F_4$ (KEEP)

$$[(P_2 \bullet C_1)+(P_3 \bullet C_2)+(P_4 \bullet C_3)+(P_5 \bullet C_4)+(P_6 \bullet C_5)+(P_7 \bullet C_6)+(P_8 \bullet C_7)+(P_9 \bullet C_8)]/256$$

(C_1-C_8) PHASE 1 $= F_5$ (KEEP)

$$[(P_3 \bullet C_1)+(P_4 \bullet C_2)+(P_5 \bullet C_3)+(P_6 \bullet C_4)+(P_7 \bullet C_5)+(P_8 \bullet C_6)+(P_9 \bullet C_7)+(P_{10} \bullet C_8)]/256$$

(C_1-C_8) PHASE 1 $= F_6$ (DROP)

$$\vdots$$

fig. 13

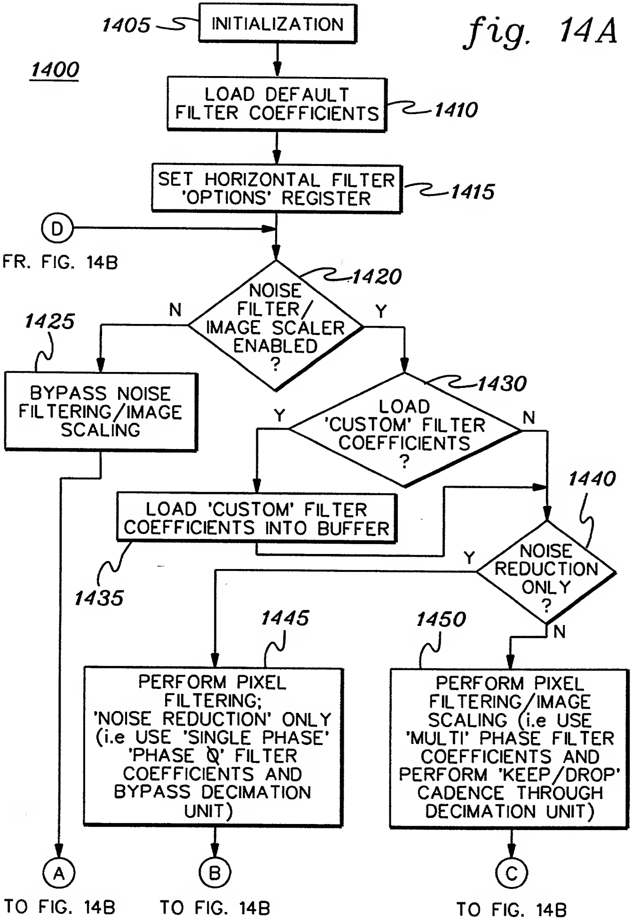

1400
1405
INITIALIZATION
LOAD DEFAULT FILTER COEFFICIENTS
1410
SET HORIZONTAL FILTER 'OPTIONS' REGISTER
1415
D
FR. FIG. 14B
1420
NOISE FILTER/ IMAGE SCALER ENABLED ?
N
Y
1425
BYPASS NOISE FILTERING/IMAGE SCALING
1430
LOAD 'CUSTOM' FILTER COEFFICIENTS ?
Y
N
LOAD 'CUSTOM' FILTER COEFFICIENTS INTO BUFFER
1435
1440
NOISE REDUCTION ONLY ?
Y
N
1445
PERFORM PIXEL FILTERING; 'NOISE REDUCTION' ONLY (i.e USE 'SINGLE PHASE' 'PHASE 0' FILTER COEFFICIENTS AND BYPASS DECIMATION UNIT)
1450
PERFORM PIXEL FILTERING/IMAGE SCALING (i.e USE 'MULTI' PHASE FILTER COEFFICIENTS AND PERFORM 'KEEP/DROP' CADENCE THROUGH DECIMATION UNIT)
A
TO FIG. 14B
B
TO FIG. 14B
C
TO FIG. 14B

fig. 14A

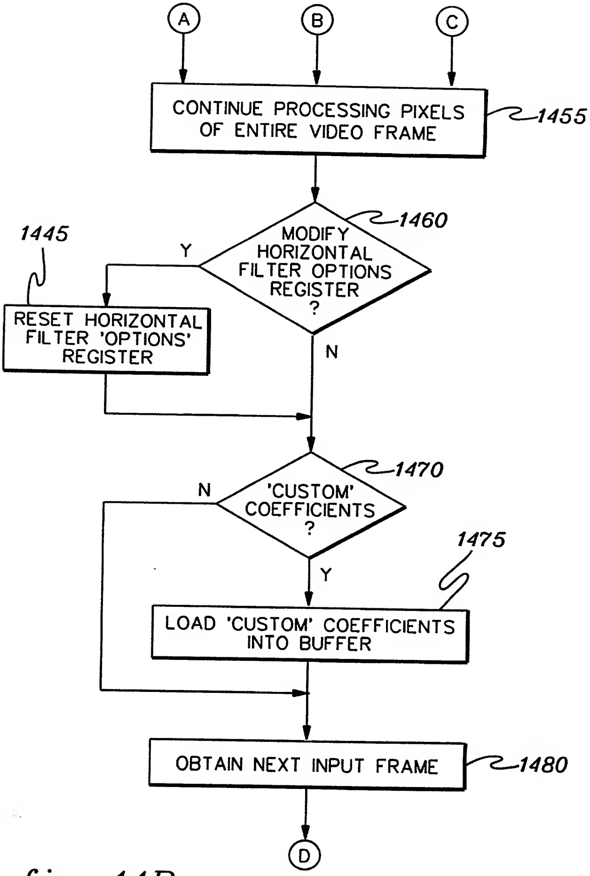


fig. 14B

TO FIG. 14A